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Evaluation of the SWAT model in the context of climate change for the Treene catchment/ Germany

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Climate change scenarios carried out with hydrological models help to assess the future development of the hydrological cycle in changing climate conditions. The application of climate change scenarios assumes that the hydrological model is able to reproduce the hydrological cycle also for changing conditions. Since the hydrological model is calibrated to recent data, it is useful to investigate this assumption in detail.
In a first step, the eco-hydrological model SWAT is calibrated in a multi-site evaluation for six hydrological stations of the Treene catchment/ Germany. In a second step, climate change scenario runs are carried out using climate input data from the regional climate model STAR. Two different future developments with linear temperature increases of 0K and 3K until 2060 are compared. The largest changes in the modeled discharge for the future period are related to the model performance of model evaluation period. By comparing monthly averaged flow duration curves, the ability of SWAT to reproduce the hydrological conditions for the future is investigated.
The multi-site calibration leads to a satisfying fit of modeled discharge time series to the observed data of the six hydrological stations under consideration of four different performance measures. Poor performance is detected for autumn months after dry summers.
The climate change scenarios illustrate lower discharges in the 3K-scenario compared to the 0K-scenario until 2060. This difference increases until 2060 and occurs especially in the autumn months.
A comparison of the future precipitation with the future discharge illustrates that the discharge reduction occurs about two months after lower precipitations in the 3K-scenario. The short-comings in the autumn months of the model evaluation for the recent period coincide with the periods of the largest effect of climate change on discharge for the future period. Thus, requirements for improvements are especially seen in the modeling of low flows. Hence, the increasing need to adapt the hydrological model SWAT and especially its short-comings to the effects of climate change becomes apparent.